reduced scrap and lay-up time, non-dependence upon drape and increased shelf life properties.

However, liquid composite moulding does possess its own problems, particularly, when the end use applications require high toughness and where control of curing cycle time is critical.

Structural parts require a high degree of toughness for most applications and this is especially true of aerospace primary components. The solution to introducing high toughness in an aerospace grade composite has traditionally been to toughen the matrix – usually by the introduction of a second phase additive such as a thermoplastic polymer to the base epoxy resin matrix.

Various approaches have been employed for the addition of a thermoplastic material into the resin. The thermoplastic may be blended with the unreacted thermoset resin at elevated temperatures to produce a single phase, unreacted melt. A limitation of this approach is the level of thermoplastic that can be added to enhance toughness. As the high molecular weight thermoplastic dissolves into the resin, the viscosity of the blend rises steeply. However the very nature of the process of introducing the resin into the reinforcing fibres requires that the resins rheological properties, viscosity and elasticity are such as to allow infiltration of the resin throughout the fabric preform. This is essential if the resulting composite structure is to be free of voids and long injection times and high injection temperatures are to be avoided. Conventional toughened epoxies are extremely viscous systems which means that high pressures and massive tools are required with the necessity of heating the resins and difficulties in matching curing time and injection-fill cycles.

Thermoplastic may also be added in the form of a continuous solid film which is placed between two layers of fibre. In such processes the thermoplastic layer is generally known as the interleaf layer. A process of this type is disclosed in European Patent Application No. 0327142 which describes a composite which comprises a solid continuous layer of a

thermoplastic material placed between two layers of fibre impregnated with thermosetting resin. On heating the thermosetting layers and the interleaf layers remain as discrete layers.

A problem with the interleaf approach is that the solid thermoplastic film does not dissolve into the resin during the heat processing stage. As a result, although the final composite may show the desired increase in toughness, there is a weak resin-thermoplastic interface. The weak interface between the interlayer and matrix can cause poor resistance to cracking between plies especially when exposed to a moist environment.

Thermoplastic material may also be introduced in a powdered form. An example of this technique is disclosed in European Patent Application No. 0274899 where the thermoplastic material is either added to the resin before the prepreg is prepared or sprinkled onto the prepreg surface.

The use of powders presents a problem in that it is difficult to ensure that an even distribution of powder is supplied to the resin. There is therefore an uneven loading of the thermoplastic material with the result that the composite will have regions of different toughnesses. Furthermore, incorporation of powdered thermoplastic material in the resin is not suitable for liquid composite moulding techniques because the viscosity of the resin is increased when the particles are added to it according to standard Newtonian theory with all the consequent disadvantages as discussed above.

If the powder particles are of a similar size to the spaces between fibres, then the process of infiltration of the resin into the fibres may also result in the thermoplastic powders being filtered out leading to an agglomeration of powder where the resin enters the mould and powder free resin in the bulk of the final composite.

Whether the powdered thermoplastic is added to the resin or to the prepreg, the amount which can be incorporated is limited. Thus, so too is the

toughening effect and, in general, to achieve a reasonable improvement in toughness, expensive structural thermoplastics have to be employed.

It has been proposed, in Japanese Patent Application 6-33329, to include thermoplastic in the form of fibres. The Application discloses a reinforcement fibre mix comprising 99-80% by weight of carbon fibres or graphite fibres and 1-20% by weight of thermoplastic resin. The composite includes only uni-directional fibres and the approach is disclosed solely as useful in a classic prepreg technique.

A good composite is one having a combination of physical properties particularly suited to a specific application. The physical properties of the composite product are determined by, amongst other things, the physical properties of the solidified resin matrix material and the structural material, and the uniformity of distribution of the matrix material and the structural material in the composite. Best results are achieved where the matrix material is intimately in contact with all of the structural material.

It is therefore desirable that the resin matrix material is of such a consistency (viscosity) that it covers (wets) all of the structural material and, if necessary, fills the interstices formed in the structural material. Uniform wetting is particularly difficult to achieve where the structural material is of complex structure, for example where it is a preform, or where the ratio of the matrix material to support is particularly low.

The viscosity of the matrix material is affected by the number and types of additives. There therefore arises the problem that, although a liquid or a gel matrix material, comprising one or more additives may possess suitable physical properties when solidified, the viscosity of the liquid or gel matrix material may be too high to facilitate its even distribution around the support material, particularly where the support is complex. This results in a composite product lacking the physical characteristics expected.

Normally to achieve a good combination of properties a composite material will consist of a number of constituents. Typically for an aerospace